Lesson 8: Dry-land Kalo
Growing new plants from stems

Summary
Students will plant the haha, stem, of the kalo (taro) plant, while learning how the term ohana is related to the oha (shoots) of the kalo plant. They will chant encouragement and protections for their keiki kalo and decorate their planters with drawings of the kalo life cycle. Once their plants have matured, they will make a snack using the kalo.

Objectives
- Students will grow new plants in a new way: from stems.
- Students will compare the rapid growth of the kalo keiki to the slower rate of their seed plants.
- Students will learn about the role of kalo in myth and lifestyle of ancient and modern Hawaiians.

Materials
Per student:
1 milk carton
1 label
1 huli (taro stem)
1 strip of construction paper (large enough to go around four sides of milk carton)
Colored markers
Glue stick/white glue/rubber cement
Science journal
Pencil
Worksheet: Kalo Identification

Per group:
½ liter water container
Tray for supplies

For the class:
2 basins
Potting soil
Newspaper if doing indoors
Large copy of taro-planting oli or song
Making Connections
Kalo (Taro) is a staple food in Hawaii and is known as the plant that gives us poi, kulolo, and laulau. Farming kalo is still a viable agricultural endeavor and producers have branched out with modern products such as taro chips, taro bread, taro pancakes, and taro cookies. The word ohana is connected to the word `oha, also known as the offshoot of the kalo plant.

Teacher Prep for Activity

E kanu i ka huli `oi ha`ule ka ua
Plant the taro stalks where there is rain.
Do your work when opportunity affords.

1. FIND A SOURCE FOR KALO HULI: Each taro plant has a 6-10 `oha of sellable size, and many more smaller offshoots that are much too small for most farmers and are the size that is best for classroom planting. Anyone with a backyard patch probably has 20-30 huli available at any time (that’s just 2-3 mature plants). Most farmers are quite willing to extend outreach and goodwill to schools. If you approach them with sincere interest and offer to pay for the huli, you will probably leave with a free basketful (better yet, see if you can take the farmer for show and tell too!). Taro is an 8-12 month crop, and harvesting is done relatively infrequently, so plan early! You need to get the huli when your farmer is harvesting. Also ask for one whole plant, with all the oha (shoots) still attached. Brush off as much soil as you can, then hose off the rest. It’s really fun for the kids to see the whole ohana. A mature plant will be taller than the students—you can find a young one that still has a nice sized corm and lots of oha.

2. PREPARING THE HULI: A huli is prepared by cutting the stem from the corm, leaving about one half to one inch of corm attached. If you cut too high, you will be able to see that there is no taro attached to the stalk and it will not grow. If you cut too low, there’s no real problem—just wasting taro could be eaten. The leaves are cut off, leaving a 6-10 inch long stalk. For this project using very small huli, the stalk will be proportionally smaller—4-5” should be fine, but you must cut high enough not to cut the new, tightly curled leaf developing in the stem. If you cut it all off, the plant will probably die. Leave one `oha intact: leaves, stem, and corm all together, for your demonstration.

image from [http://www.canoeplants.com/kalo.html](http://www.canoeplants.com/kalo.html)

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3. **COLLECT MILK CARTONS:** Have students bring in their milk cartons from lunch, rinse, and dry them. Place cartons on lawn outside. Poke several holes in the base using a pencil, always from inside to outside, to avoid making a lip.

4. **CUT CONSTRUCTION PAPER:** Trace the sides of a milk carton onto construction paper, so you have one long strip that will go all the way around. Cut out one strip per child, so that there will be a “cover” to glue on each side of the milk carton.

5. **PREPARE AN OLI:** Contact a kupuna you know, or search the Bishop Museum Teacher Resources Pages for some excellent ideas: on their website there are written accounts, in English, of the types of chants that should be done at each planting stage and an oli, (in Hawaiian, no English translation). Waikoloa students sang Robi Kahakalau’s “Keiki O ka Aina” which they had been preparing for their songfest, talks about Waipio Valley, a major taro-producing center. They also repeated boisterous phrases from a chant found on the museum website, imploring the demigod Kamapua’a (half man and half pig) to till and protect the field and to other gods to rain and shine on their growing taro.

**Definitions:**
- **kalo:** the taro plant, sometimes specifically the corm. Central to Polynesian diet and Hawaiian culture.
- **mala:** garden
- **taro:** another word for kalo
- **corm:** a modified stem, capable of storing energy in the form of carbohydrate. Most corms have growth nodes, from which new plants can develop.
- **stem:** the structure of a plant with vascular tissue (like veins) that supports leaves and flowering parts.
- **haha:** stem
- **oha:** offshoot of taro: includes its own corm, roots, stem and leaves
- **ohana:** family
- **huli:** part of kalo used for planting. The stem, with most leaves cut off, and a bit of taro at the base.


**Background**
From early times, kalo was the primary food of the people of Hawai`i, supplemented by other principal and traditional foods: breadfruit (ʻulu), sweet potato (ʻuala), yams, greens, ferns, fruit, fish and seaweed (limu). According to the Kumulipo, the creation chant, kalo grew from the first-born son of Wakea (sky father) and Papa (earth mother). Haloa-naka, as the son was named, was stillborn and buried. Out of his body grew the kalo plant, also called Haloa, which means everlasting breath. The kalo plant is said to be the hiapo, the number one sibling, of people. It is also said to be the kinolau, the body form, of Kane, the procreator. The small round depression where the taro stalk meets the leaf surface is called the piko, from whence comes the name for the human belly button. Just as Kalo and poi were once the means to survival of a pioneering people, today it is a symbol of cultural survival, with ritual sharing of the ʻumeke (poi bowl) to show appreciation for our living and ancestral ʻohana becoming common once again.
Taro grows in tropical Africa, the West Indies, the Pacific nations, and in countries bordering the Indian Ocean in South Asia and has been a staple throughout the tropics and subtropics. It was brought to Hawaii by the earliest Polynesian settlers, who developed more than 300 varieties of taro. Approximately 87 of these varieties are still recognized today, with slight differences in height, stalk color, leaf or flower color, size, root type, and food quality. Some of the local varieties are Mo`i, Lehua, Ha`akea and Chinese.

Taro, whose scientific name is *Colocasia esculenta* (or antiquorum) is cultivated both in the uplands as high as 4,000 feet, as dry-land taro, and in marshy land irrigated by streams-wetland taro, or taro lo`i. The plant is a hearty succulent perennial herb, with clusters of long heart shaped leaves that point earthward. Taro grows on erect stems that may be green, red, purple, black or variegated. The new leaf and stem push out of the innermost stalk, unrolling as they emerge. The stems are usually several feet high. Tiny new plants (oha) appear around the base of the root corm. The pua, inflorescence, is an open yellow-white tube, enclosing a spike covered with flowers.

The whole plant is used or recycled. The kalo (corm) and luau (leaves) are eaten, and the huli are replanted. For some varieties, all parts can be eaten. The leaves are cooked as greens, similar to spinach. The tubers are eaten baked, boiled or steamed, or cooked and mashed with water to make poi. The fibrous flesh of the tubers is tough and spongy, ranging in color from white, yellow, lilac-purple, and pink to reddish. Most important is the starchy root with enough glutinosity to make quality poi. The stiffest poi is called locally "one finger" and the most liquid "three finger". "Two finger" poi is considered the best by some. The planters know which kind of taro makes the best poi, which variety has the tenderest leaves, and which has the necessary medicinal properties.

Taro is often fed to babies as their first whole and natural healthy food, as well as to the elderly, for its ease of digestion and high vitamin content. Poi is eaten fresh or allowed to ferment for a few days, often for longer, creating a sour taste considered pleasant, acid, but not alcoholic. In the old days, a person might consume up to five pounds of poi per day. Several kinds of kalo had such special flavor and color that they were reserved only for the chiefs. It is said that Soviet astronauts ate dehydrated taro in space, adding water to the packets...instant poi!

In the kalo and poi-based agricultural society, the people of ancient Hawai`i were dependent on all parts of the kalo. Great skills were needed to terrace, cultivate and irrigate the land along streams, as well as the social and political skills to maintain it. The planters of wetland taro were practicing engineers, building walls of earth reinforced with stone to enclose the lo`i (pond field). Along the banks of the lo`i were planted mai`a (banana), ko (sugarcane), ki (ti), and wauke (paper mulberry) for kapa cloth, also known as tapa. In the pond field, several varieties of fish were raised, such as `awa, `ama`ama, o`opu and aholehole. The lo`i also provided habitat for waterbirds, native insects, and mollusks. An acre of wet lo`i could produce 3 to 5 tons of food per year, due to the constant flow of water and the inputs and exchanges of energy and nutrients between all these members of the kalo food web. Today there are still functional lo`i along the Keanae, Wailua and Hana coastlines of Maui; Waipio Valley, Hawaii; Hanalei, Kauai; and other locations throughout the Hawaiian islands.
Dry-land taro was grown in the lower forests where the soil was rich and the rainfall sufficient. Stone borders surrounded these gardens (mala) and can still be found on a forest hike. While yields were smaller and tending more intensive, dry-land taro could be grown in mala without the substantial initial engineering and investment of a lo`i. In fact, in pre-contact Hawai`i, more people relied on dryland taro than on that grown in lo`i.

Once a huli is ready for planting, there are certain protocols (chants) a Hawaiian person would do before planting. Please contact a kupuna you know, or search the Bishop Museum Teacher Resources Pages for some excellent ideas. There are written accounts, in English, of the types of chants that should be done at each planting stage, and an oli (in Hawaiian, no English translation). Waikoloa students sang “Keiki O ka Aina” which they had been preparing for their songfest, which talks about Waipio Valley, a major taro-producing center. They also repeated boisterous phrases from a chant off the museum website, imploring the demigod Kamapua`a (half man and half pig) to till and protect the field, and other gods to rain and shine on their growing taro.

A taro farmer exemplifies self-sufficient stewardship of natural resources through hard work. There is wisdom in encouraging and supporting community as well as back-yard cultivation of this valuable food.

In planting wetland and dry-land taro, the huli, the planting material, consists of a 1/2 inch thick slice of the top of the kalo (corm, from which derives the plant's name) attached to 6 to 10 inches of the leaf-stem. These protrude above the water or dry-land where planted.

The bottom of the corm/root is saved for cooking and eating, making taro a recyclable plant. In 6 to 12 months, depending upon plant variety along with soil and water conditions, the taro should be ready to harvest. Each parent tuber produces 2 to 15 `oha, or offshoot corms, up to 6 inches in diameter. `Oha means specifically, the suckers or shoots concentrically growing from the corm of the kalo/taro plant. Knowing this, it is easy to understand why the Hawai`i family as a group is termed `ohana, which literally means "all from the shoots".

Before kalo can be eaten, all parts of the plant must be cooked, in order to break down the needle-like calcium oxalate crystals present in the leaves, stem, and corm. These could be extremely irritating to the throat and mouth lining, causing an acrid burning and stinging sensation.

Lu`au is the name of the edible taro leaf, from the word lau which means leaf. The word lu`au used to mean a party (pa`ina) or celebration today, seems to be a mistranslation dating back over a hundred years. Lu`au supplies high amounts of vitamins A, B and C, as well as calcium, iron, phosphorus, thiamine and riboflavin. The cooked corm and poi have fewer vitamins, but are an excellent carbohydrate source.

Mud from the taro patch was used as a black dye for lauhala and kapa cloth, while some leaf-stem juice yielded red dye. Also, diluted poi was used as a paste to glue together pieces of kapa cloth.
If we want to learn more about kalo and how to grow it, it is a good idea to talk to the farmers who already cultivate it. Many of these are eager to share their knowledge and expertise and many fascinating stories about this plant so central to the life of Hawai‘i and her people. Exchanging stories and taro varieties with friends and neighbors is the Hawai‘i way.

**Procedure**

1. **INTRODUCTION:**
   a. Bring in some display items, such as a potted kalo (taro) plant, a bag of poi, laulau, and a picture or model canoe.
   b. Ask the students what they think they’ll be learning about today.
   c. Find out what the students know about kalo, if they have eaten it, and what they know about the first Polynesian settlers of Hawai‘i.
   d. How do they think kalo got here?
   e. Discuss settlement of Hawaii briefly.
   f. Has anyone ever seen a kalo seed? How do you get new kalo plants?

2. **DISCUSS STEMS**
   a. Take the intact huli and point out the leaves, stem, and corm.
   b. Explain that a corm is often thought of as a root, but it is really a special kind of stem.
   c. The plant stores energy in the form of starch in this stem. This energy is used by the `oha, or keiki as they grow in the shade of the parent plant. Once they can get enough sunlight, they begin to store their own energy in their corms.
   d. As you point out the leaves of the plant, mention the piko—just like the belly-bottom that once connected each of us to our mothers.
   e. Remind the students of their seed plants growing around the classroom. Do they have stems?
   f. What is at the top? [Leaves]
   g. What is at the bottom? [Roots]
   h. Explain that taro can grow leaves and roots from its stem: even if the ones growing there now are cut off, the energy in its stem helps it to survive. When the Polynesian voyagers set off to find Hawaii, they wanted to bring their kalo with them.
   i. Show a picture or model of a voyaging canoe. There is very little space on board a canoe. By trimming the plants down to the very smallest part that will still grow, they could bring a lot of huli, or keiki kalo, with them on the canoe.
   j. Cut off the leaves and the corm.
   k. Show the students the speckled starch inside the corm, and in the base of the stem. Starch is a form of stored energy that can fuel the growth of a new plant.

3. **RECORD OBSERVATION**
   a. Fold the piece of construction paper into fourths, one for each side of the milk carton.
   b. On the first square, draw what the kalo looks like as a huli.
   c. Students should tuck this strip of paper into their science journals for later.
4. MOVE TO OUTSIDE PLANTING AREA AND DISCUSS PROTOCOL

Tell the students that planting was not just something you did anytime, any way you wanted. You had to ask the gods for help and permission first. If you have been working on an oli chant or song for this occasion, ask the students to perform it before planting the huli.

5. PLANTING

Tell the students: Now we are ready to plant—we have prepared our minds, bodies, and our huli. Divide into groups, and have each group assign a “getter.” Getters should come up and get a milk carton and crayon for each student in the group.

a. Label side of milk cartons with name using crayon.
b. Fill with dampened soil. As students do this step, pass out huli to each group.
c. Place huli into soil—half way down into carton.
d. Cover with additional soil if needed. As students complete this step, pass out water containers and paper towels. Stapling the top of the milk carton shut will hold the huli in place.
e. Add water—about 4 oz each.

6. GATHER KALO INTO A “MALA” (GARDEN)

a. Place all planters into a tray or soda box.
b. Teach the students the word “mala” for garden.
c. Milk cartons don’t work well for the watering in the tray method. Since this is dry-land kalo, water will be poured from above into the cartons as needed.
d. Place tray outside in full sun.
e. Attach a sign letting other students know what you are growing and that they should be gentle with your kalo `ohana.
f. Tray can stay outside in a secure location or be brought in each afternoon or weekend.
g. Taro grown indoors will grow tall and spindly trying to find sunlight, unless it has a strong grow light. You could keep one plant indoors to show this.

13. MAKE OBSERVATIONS REGULARLY.

a. Draw the kalo again when the first leaf appears (within a week or two).
b. The kalo will quickly outgrow the milk carton, so have students draw what they think the kalo will look like at the mature leaf stage (square 3), and at the mature corm stage (square 4) or let them copy from an image in a book (see taro book resources).
c. Once all four squares have been recorded, students should glue the paper around their milk carton, and take the kalo home or donate to school garden.

14. REVIEW KALO PLANTING AT HOME.

a. Pick a spot where there is good soil and plenty of water.
b. Planting under the eaves of a house allows the kalo to get nearly full sun and still catch the drips of even a light rain.
c. Although some kalo is adapted to underwater growth, dry-land varieties actually need well-drained soil to develop healthy corms.
d. Bury the huli 6 inches deep—it’s ok if some leaves get buried, but the new leaf should stick up into the sun.
e. Kalo corms grow up from the base of the huli, not down like a carrot, so every few months, pile a 2-4” high mound of dirt around the base, for a nice big harvest.

f. In very rocky areas, the kalo can grow in a large pot, or right on top of cinders:
   i. Cut the bottom out of a 2-3 gallon flower pot to make a cylinder.
   ii. Place kalo inside the open cylinder on the ground and fill to the top of the corm with soil.
   iii. Add a few inches of fertilized soil every few weeks as the plant grows
   iv. Water everyday.

Assessments
Students record drawings of the kalo plant that reflect realistic observations.
Students correctly label the parts of the kalo on the Kalo Worksheet.

Resources
Bishop Museum Website has an educator’s resources section, with old archival documents and photos worth checking out. Note that their copyright rules prohibit direct copying, but recording an oli on chart paper for your class to learn or displaying the old photos with a projector from your computer should be permissible.
http://www.hawaiialive.org/topics.php?sub=Early+Hawaiian+Society&Subtopic=115

Lots of helpful taro info at: http://www.canoaplants.com/kalo.html


Extension Activities
Visit a kalo lo`i or mala. The Amy Greenwell Botanical Garden on Hawaii, Nature Centers on Maui and Oahu, Waimea Valley on Oahu, Waipio Valley on Hawaii, and Hanalei on Kauai all have organized tours and programs. Many of the larger taro farms may supplement income by providing tours for minimal per-person fees. Start asking around, and you will be surprised who grows a little taro on the side and would be willing to give a tour or demonstration. Incorporate SS.2.7.1 by identifying the use of natural slopes and plateaus, human-made irrigation ditches and walls in the kalo terraces. Emphasize how agriculture is the earliest and most critical area of technology developed by humans, and how the technology of ditches and irrigation allowed the human populations of Hawaii to grow, just as modern agricultural technology supports the world’s large populations today.

Lu`au time! Find one of the many local, Hawaiian, or taro cookbooks and make a feast at school, or assign one dish to each student. Remember, all parts of the taro plant must be very well cooked to break down the acid crystals. No itchy mouth! Look into buying taro and leaf in bulk directly from a farmer (commercial taro wholesale is only $0.55 a pound, leaf ranges 1.50-2.50/lb).
Taro chips are sure to please. Though easier to slice with a mandolin, you can manage with a very sharp, non-serrated chef knife. Peel skin off of raw corm, and slice as thinly as possible. Heat oil in a big pot on med-high, and when very hot, add slices of taro in small batches. Taro slices are very sticky and must be drop in separately. Cook for 4-6 minutes or until the chips are just starting to turn golden-brown. Drain onto paper towels. Salt and eat. Oil may be re-used several times then given to a friend who makes biodiesel!

Culture/Art/Math/Literature Connections

My Hawaiian Farm: Not a spectacular book, though it does have cute pictures with native animals peeking from their hiding places around the farm. The story takes you through the months of the year, telling what major crop the family farm is harvesting on each page. Told from the perspective of a young girl.

A Legend: How Makaha Got Its Name, by Edward Iopa Kealanahele. The people of a valley in Waianae depend on the rain for their taro crops, but a prolonged drought makes life hard. The chief of the valley charms the rainbow goddess of Manoa into bringing the much needed rain, and the valley is named Makaha in his honor.

Puapualenalena and the Magic Kiha-pu, by Guy Buffet. This story tells the story of the magical trickster dog of Waipio, who retrieves the trumpet shell and saves his skin. Just one of several versions of this children’s favorite, see http://www.hawaiianwalkways.com/content/view/47/89/ for a review of others.

Botanical Diversity: When your students tell you they have taro climbing a tree or growing in a stream near their house, is it really taro? Taro has lots of close neighbors, many of which are barely edible as famine food, or quite toxic. `Ape, for instance, was probably used as famine food from time to time, and is commonly called wild taro. You can tell the difference by the piko: If the stem attaches in the middle of the leaf, you have taro. If it is touching the inside point of the “V” in the heart shaped leaf (the crotch of the leaf), you have `ape. Philodendrons (elephant ear plants and vines) grow wild on all the wet parts of our islands. The sap from these plants can cause a painful swollen rash. Pick up a book on tropical landscape plants, poisonous plants of Hawaii (Poisonous Plants of Paradise, see Lesson 1), or visit a plant nursery to learn to identify taro’s many cousins and bring in some examples for your students—with caution.

Math: Measure the growth of your kalo plants every few days, just as you did for your brassica or grass. Plot the growth rate of your kalo plants (the amount it changes everyday vs the number of days since planting) on the same chart with your seed plants. (You can use the one you did previously and just add on, or chart the seed growth over again). Why does the kalo grow so much faster? [it uses the energy stored in its corm to get a head start. The seed also had stored energy, but you can tell by the size of the seed, it had much less of a head start. Also, the leaves are much bigger when they first open on the kalo—this allows it to collect even more sunlight energy to keep up its fast growth.] Will this trend continue? [Students can discuss possibilities, but both the brassica and the taro will grow to a somewhat predetermined size, then die back. The taro get much larger than the brassica, but then stays at that size for a long time (the growth rate line would flatten out)].
Art: The taro drawings on the wrappers for the milk cartons can be quick sketches or serious pieces of art. Use good sketch paper instead of construction paper for better drawings. Check out a book on Polynesian tattoo patterns and use those to frame the drawings.

Use real clay to make a kalo leaf plate. Save the leaves you cut off of your huli (desert-plate sized or even shoyu bowl sized) and slice the stem off flush with the leaf. Then slice a 1/4-1/2” thick slab of clay for each student. Have students work the clay until it is wide enough to press the entire leaf firmly into the clay, vein-side down. Use a plastic butter knife to trim around the edge of the leaf. Roll your hand over the surface of the leaf to be sure all the texture of the leaf is transferred. Use wads of newspaper or paper towels to hold the leaf edges in a natural leaf shape, or press your sculpture flat, and bend just the edges up slightly like a real plate. Peal leaf off carefully and discard. Allow to dry and glaze or bake according to the type of clay used. Used more taro leaves or other plants to stamp tissue paper to wrap the gift.
Can you label the parts of the Kalo in English and Hawaiian?

Use these words:

kalo    corm    'ohā    ha    leaf
stem    huli    huluhulu    piko


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Can you label the parts of the Kalo in English and Hawaiian?

piko, bellybutton

lau (luau), leaf

haha, stem

Oha, shoot

kalo, corm

huluhulu, root

Use these words:
kalo  corm  'ohā  hā  leaf
sp  sp  huli  huluhulu  piko
cutting  root  lau  bellybutton  shoot